Sick on the Frontlines: COVID-19 Infection and Symptoms among Emergency Medicine Residents and Fellows in Urban an Academic Hospital Setting: A Cross-Sectional Questionnaire Study

Stacey Frisch, Sarah Jones, James Willis, Richard Sinert

Submitted to: JMIRx Med
on: April 11, 2021

Table of Contents

Sick on the Frontlines: COVID-19 Infection and Symptoms among Emergency Medicine Residents and Fellows in Urban an Academic Hospital Setting: A Cross-Sectional Questionnaire Study

Stacey Frisch[1] MD; Sarah Jones[2] MD; James Willis[1] MD; Richard Sinert[1] DO

[1]SUNY Downstate Health Sciences University Brooklyn US
[2]Jackson Health System Miami US

Corresponding Author:
Stacey Frisch MD
SUNY Downstate Health Sciences University
450 Clarkson Ave
Brooklyn
US

Abstract

Background: COVID-19, an illness caused by the novel coronavirus SARS-CoV-2, affected many aspects of healthcare worldwide in 2020. From March to May of 2020, New York City (NYC) experienced a large surge of cases.

Objective: The authors aimed to characterize the amount of illness experienced by residents and fellows in 2 NYC hospitals during this time period.

Methods: This was a cross-sectional observational study. An IRB-exempt survey was distributed to emergency medicine housestaff in May 2020 and submissions were accepted through August 2020.

Results: 64 residents and fellows responded to our survey (a 62% response rate). 42% of responders tested positive for SARS-CoV-2 antibodies. Most residents experienced symptoms that could be consistent with COVID-19 however few received PCR testing. Fevers and/or chills along with loss of smell and/or taste were the most specific symptoms for COVID-19, with p-values <0.05. All 13 housestaff who reported no symptoms during the study period tested negative for SARS-CoV-2 antibodies.

Conclusions: Our study demonstrated that the rate of COVID-19 illness among emergency department housestaff is much higher than previously reported. Further studies are needed to characterize illness among medical staff in emergency departments across the nation. The high infection rate among emergency medicine trainees stresses the importance of supplying adequate PPE for healthcare professionals.

(JMIR Preprints 11/04/2021:29539)
DOI: https://doi.org/10.2196/preprints.29539

Preprint Settings

1) Would you like to publish your submitted manuscript as preprint?

✓ **Please make my preprint PDF available to anyone at any time (recommended).**
Please make my preprint PDF available only to logged-in users; I understand that my title and abstract will remain visible to all users.
Only make the preprint title and abstract visible.
No, I do not wish to publish my submitted manuscript as a preprint.

2) If accepted for publication in a JMIR journal, would you like the PDF to be visible to the public?

✓ **Yes, please make my accepted manuscript PDF available to anyone at any time (Recommended).**
Yes, but please make my accepted manuscript PDF available only to logged-in users; I understand that the title and abstract will remain v
Yes, but only make the title and abstract visible (see Important note, above). I understand that if I later pay to participate in <a href="http

Original Manuscript

Sick on the Frontlines:

COVID-19 Infection and Symptoms among Emergency Medicine Residents and Fellows in Urban an Academic Hospital Setting: A Cross-Sectional Questionnaire Study

S. Frisch, MD, S. Angarita-Jones, MD, MPH, J. Willis, MD, R. Sinert, DO

S. Frisch is a chief resident, Department of Emergency Medicine, Department of Emergency Medicine, SUNY Downstate Medical Center/Kings County Hospital Center, Brooklyn, NY, USA, ORCID: https://orcid.org/0000-0003-3697-2234.

S. Angarita-Jones is an attending physician, Department of Emergency Medicine, Jackson Health System, Miami, FL, USA.

J. Willis is an attending physician, Department of Emergency Medicine, SUNY Downstate Medical Center/Kings County Hospital Center, Brooklyn, NY, USA.

R. Sinert is an attending physician, Department of Emergency Medicine, SUNY Downstate Medical Center/Kings County Hospital Center, Brooklyn, NY, USA.

Correspondence should be addressed to Stacey Frisch, Department of Emergency Medicine, Dept of Emergency Medicine, Kings County Hospital, 451 Clarkson Avenue, CG27A- C building, Ground Floor, Room 27A, Brooklyn, NY 11203. staceyfrischmd@gmail.com; Phone: 718-245-3318. Fax: 718-245-4799. Twitter: @EmergenStacey

ABSTRACT

Background: COVID-19, an illness caused by the novel coronavirus SARS-CoV-2, affected many aspects of healthcare worldwide in 2020. From March to May 2020, New York City (NYC) experienced a large surge of cases.

Objectives: The authors aimed to characterize the prevalence of illness and symptoms experienced by residents and fellows in 2 NYC hospitals during this period.

Methods: An IRB-exempt survey was distributed to emergency medicine housestaff in May 2020, and submissions were accepted through August 2020.

Results: 64 out of 104 residents and fellows responded to our survey (a 62% response rate). 27 out of 64 (42%) responders tested positive for SARS-CoV-2 antibodies. Most residents experienced symptoms that could be consistent with COVID-19; however, few received PCR testing. 18 out of 27 (67%) housestaff with SARS-CoV-2 antibodies experienced fever and chills compared with 8 out of 34 (24%) of housestaff without SARS-CoV-2 antibodies. 19 out of 27 (70%) of housestaff with SARS-CoV-2 antibodies experienced loss of taste and smell, compared with 2 out of 34 (6%) housestaff without SARS-CoV-2 antibodies. Both fever and chills and loss of taste and smell were significantly more commonly experienced by antibody-positive compared to antibody-negative housestaff (*P*-values .002 and <.001, respectively). All 13 housestaff who reported no symptoms during the study period tested negative for SARS-CoV-2 antibodies.

Conclusions: Our study demonstrated that the rate of COVID-19 illness among emergency department housestaff is much higher than previously reported. Further studies are needed to characterize illness among medical staff in emergency departments across the nation. The high infection rate among emergency medicine trainees stresses the importance of supplying adequate PPE for healthcare professionals.

INTRODUCTION

Coronavirus Disease 2019 (COVID-19) is a viral respiratory illness caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) virus that has plagued the world since 2020. By March 2020, COVID-19, also known as novel coronavirus, reached epidemiological criteria for a global pandemic [1]. After its initial identification in Wuhan, China, COVID-19 quickly spread across the world [2]. Since COVID-19 was first identified in the United States (US) on January 15th, 2020, in Seattle, Washington, the US has had the largest number of confirmed cases. To date, the United States has had over 13.8 million COVID-19 cases, with over 320,000 of those from New York City alone [3]. New York City experienced a massive surge of cases between March and May 2020.

At the time of the writing of this article, the county of Kings, New York, also known as the city of Brooklyn, has seen the highest number of COVID-19 related deaths in the United States at over 24,000 [2]. SUNY Downstate Medical Center and Kings County Hospital are state and public city hospitals located in central Brooklyn. The emergency departments in both hospitals are staffed primarily by Board Certified Emergency Medicine (EM) Attending Physicians and EM residents. As of November 18, 2020, Kings County Hospital cared for 2,701 COVID-19 patients and reported 348 COVID-19 related deaths. As of November 18, 2020, SUNY Downstate Medical Center, which was designated a “COVID-19 only facility” by the state governor’s mandate [4], admitted 864 COVID-19 patients and reported 298 deaths.

Resident physicians in teaching hospitals act as the front lines of the emergency department, intensive care units, and clinics. Given the large volumes of patients they see over long and frequent shifts, their exposure rates are perceived to be great. Furthermore, this study includes SARS-CoV-2 exposures early in the first wave when Personal Protective Equipment (PPE) was limited and before stockpiles were mandated in NY.

This study aims to evaluate the SARS-CoV-2 exposure of emergency medicine resident physicians and fellows working at the above-mentioned urban academic medical centers. After

quantifying the exposure, their symptoms, the number of patients with COVID-19 treated and intubated, and perceived adequacy of PPE was correlated with residents' and fellows' antibody test results.

METHODS

Study design, setting, and population

A cross-sectional survey study was conducted at SUNY Downstate Medical Center and Kings County Hospital Center in Brooklyn, NY, among individual emergency medicine residents and pediatric emergency medicine fellows.

Study protocol

The open 20-question electronic survey questionnaire was generated using the Qualtrics Survey platform (Qualtrics, Version August 2020. Provo, UT) and the technical functionality of the survey on the Qualtrics platform was tested prior to distribution. The survey was self-administered in May 2020 via email listserv to the residents and fellows of the SUNY Downstate Emergency Medicine Department. The survey and investigation received IRB exemption status from the SUNY Downstate IRB with participant consent waived. Participation in the study was voluntary, and no compensation was given for participation. Completeness checks were not performed automatically, but participants were able to review their responses prior to submitting. Results were automatically captured in the Qualtrics system, and were kept anonymous and confidential. IP addresses were used to ensure unique responses and identify potential duplicate entries.

During the study period, residents were offered three laboratory options for SARS-CoV-2 IgG antibody testing:

1. Wadsworth Center (WC) microsphere immunoassay (MIA) [5], performed at the public health laboratory of the New York State Department of Health (NYSDOH)

2. Abbott Laboratories Inc chemiluminescent microparticle immunoassay (CMIA) [6], performed at Quest Diagnostics
3. Abbott ARCHITECT [6] nucleocapsid immunoassay analyzer, performed at University Hospital of Brooklyn Laboratory

Residents that had RT-PCR (PCR) testing were offered the following tests from our institutions:

1. Hologic Panther Fusion® System [7], performed at Lenco Diagnostic Laboratory (March 2020)
2. Cepheid GeneXpert®Systems [8], conducted at University Hospital at Brooklyn Laboratory (April to August 2020)
3. BioFire® Respiratory 2.1-EZ (RP2.1-EZ) Panel [9], conducted at University Hospital at Brooklyn Laboratory (July to August 2020)

Key outcome measures

Survey questions (see Appendix) included a range of options for the total number of patients with COVID-19 that the housestaff were exposed to, the total number of patients with COVID-19 that the housestaff intubated, average clinical weekly hours worked, symptoms of illness, and whether or not the housestaff felt PPE provided was adequate. The survey questions referenced the period between February 2020 and until survey completion. Results were collected through August 2020.

Data analysis

Survey responses were tabulated and compiled in table format with ranges. Frequency data were reported as percentages with 95% Confidence Intervals (95%, CI). Fisher's Exact Test analyzed group comparisons. Alpha set as 0.05; all tests were 2-tailed. IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.

RESULTS

Table 1	Demographics of Survey Participants	
Characteristics	Category	Total Number (%)
		(n=64)
Age (years)	26-30	39 (61%)
	31-35	21 (33%)
	36-40	4 (6%)
Postgraduate Year	1	13 (20%)
(PGY)	2	20 (31%)
	3	14 (22%)
	4	12 (19%)
	5+	5 (8%)
Gender	Female	33 (52%)
	Male	31 (48%)
Clinical Hours	11-20 hours	1 (2%)
(average/week)	21-30 hours	4 (6%)
	31-40 hours	11 (17%)
	41-50 hours	17 (27%)
	51-60 hours	23 (36%)
	61-70 hours	6 (9%)
	71-80	2 (3%)
COVID-19 PCR test	Positive	9 (14%)
	Negative	8 (12%)
	Indeterminate	1 (16%)
	Did not take PCR test	46 (72%)
Antibody test	Positive	27 (42%)
	Negative	34 (53%)
	Indeterminate	1 (16%)
	Did not take antibody test	2 (3%)

From Table 1, 64 out of 104 residents and fellows responded to the survey yielding a 62% response rate. There were no duplicate entries and all surveys were completely filled out. Of the 64 housestaff, 27 (42%) were positive for SARS-CoV-2 IgG antibodies, two residents did not undergo antibody testing, and one resident had indeterminate results. Most of the respondents were female (33 of 64, 52%) and between 26-30 years of age (39 of 64, 61%). The most common post-graduate

year (PGY) was PGY2, with PGY3 and PGY1 second and third most common, respectively. Housestaff mostly (23 of 64, 36%) worked 51-60 hours per week. The majority of study participants (46 of 64, 72%) did not take a SARS-CoV-2 PCR test, but 62 of 64 (97%) of respondents had taken a SARS-CoV-2 antibody test. All residents with a positive PCR (N=9) also had a positive antibody test.

Table 2 Characteristics comparing COVID-19 IgG antibody-negative to antibody-positive residents

	Category	Antibody-Negative n (%)	Antibody-Positive n (%)	*P*-value
		(n=34)	(n=27)	
Number of patients treated	<10	1 (3%)	1 (4%)	1.000
	10-20	0 (0%)	1 (4%)	1.000
	20-40	8 (24%)	4 (15%)	.520
	40-60	8 (24%)	7 (26%)	1.000
	60-80	6 (18%)	5 (19%)	1.000
	80-100	2 (6%)	1 (4%)	1.000
	>100	9 (26%)	8 (30%)	1.000
Number of patients intubated	<5	26 (76%)	20 (74%)	1.000

	5-10	2 (6%)	6 (22%)	**.049**
	10-15	3 (9%)	1 (4%)	**.023**
	15-20	3 (9%)	0 (0%)	.250
Resident symptoms of illness	Fever/chills	8 (24%)	18 (67%)	**.002**
	GI symptoms	8 (24%)	8 (30%)	.770
	Upper respiratory symptoms	13 (38%)	15 (56%)	.205
	Loss of taste/smell	2 (6%)	19 (70%)	**< .001**
	Headache	11 (32%)	11 (41%)	.395
	None	13 (38%)	0 (0%)	**< .001**
Adequate PPE	Yes	18 (52%)	11 (41%)	.441
	Maybe	10 (29%)	9 (33%)	.786
	No	6 (18%)	7 (26%)	.247

a. **Bold text** indicates $P < 0.05$

Table 2 compares COVID-19 exposure between those residents who tested antibody-positive versus antibody-negative for SARS-CoV-2 virus. There was no significant difference in the risks of a positive antibody test based on the number of COVID-19 patients the respondents treated during the study period. Most respondents (46 of 61, 75%) intubated less than 5 COVID-19 patients at the time of the survey, which left too few events to accurately compare the number of intubations to the risks of becoming antibody-positive. A significant difference in symptoms was noted between antibody-positive and antibody-negative residents. Although none of the antibody-positive residents were without symptoms, 21 of 34 (62%) of antibody-negative residents had a symptom commonly associated with COVD-19 infection.

18 out of 27 (67%) housestaff with SARS-CoV-2 antibodies experienced fever and chills compared with only 8 out of 34 (24%) of housestaff without SARS-CoV-2 antibodies. 19 out of 27

(70%) of housestaff with SARS-CoV-2 antibodies experienced loss of taste and smell, compared with only 2 out of 34 (6%) housestaff without SARS-CoV-2 antibodies. Both fever/chills and loss of taste and smell were significantly more commonly experienced by antibody-positive compared to antibody-negative housestaff (*P*-values .002 and <.001, respectively). Gastrointestinal (GI) and upper respiratory symptoms and headache did not appear to correlate to antibody status. The perception of the adequacy of PPE was similar regardless of antibody status.

DISCUSSION

Our survey had an adequate response rate of (64/104) 62%. Overall, 27 of 64 (42%) of our residents and fellows tested positive for SARS-CoV-2 antibodies, indicating a high exposure rate within the first few months of the pandemic. No residents or fellows were hospitalized. In residents who had SARS-CoV-2 antibodies, the most common symptoms experienced during the study period were loss of smell and taste (19 out of 27, 70%), fever/chills (18 out of 27, 67%), and upper respiratory symptoms (15 out of 27, 56%).

Sabetian et al. found a SARS-CoV2 infection rate of 5.62% among 4854 healthcare workers in Southwest Iran between March and May 2020 [10]. They found that the highest infection rate was in the emergency room workers (30.6%), which is comparable to our 42% of housestaff. Breazzano et al. surveyed cross-specialty program directors in NYC in April 2020, accounting for 382 emergency medicine residents, and found 6.5% confirmed, 8.4% presumed, and 3.1% suspected for COVID-19 infection [11]. This is much lower than the 42% of housestaff infected in our study period because our study period extended through a longer time period, which allowed for more exposure and more testing available in NYC. A more recent study in California, US, conducted from September to October 2020, found only 2.9% of their emergency department staff (n=139) had antibodies for SARS-CoV-2 [12]. This study had a much lower infection rate than ours, possibly because it was conducted before the largest surge in California. Additionally, the New York City

COVID-19 surge was the first large surge in our country, and we were unprepared with protective equipment. By the time the California study was conducted, hospital workers were wearing N-95 masks universally. Lumley et al. investigated healthcare workers in the UK, and found that 1265 out of 12,541 (10%) healthcare workers had SARS-CoV-2 antibodies by November 30, 2020 [13]. Their antibody prevalence was much less than our 42% antibody prevalence, possibly because their study included healthcare workers who may have less patient contact hours, such as administrative staff and laboratory staff, and their study period concluded before the UK's largest COVID-19 spike.

The percentage of physicians in training in our emergency departments who developed SARS-CoV2 antibodies was more than those previously reported. This is likely multi-faceted and could be due to the high-risk nature of our specialty, the use of antibody testing in addition to PCR testing to determine exposure, location regulations, and our hospital and regional setting. Antibody testing captures the incidence of infections over a longer timeframe (both active and past infections) compared to PCR testing, which is usually only positive in an active infection. Additionally, our practice area of Flatbush, Brooklyn, was a COVID-19 hotspot, and the University Hospital of Brooklyn was identified as a COVID-19 only facility by governor mandate [4], which may have increased housestaff exposure.

Shahriarirad et al. investigated symptoms experienced by patients in Iran with COVID-19 and found that the most common symptoms at the onset of disease were fatigue (66.4%), cough (64.6%), and fever (59.3%) [14]. In our study, residents with SARS-CoV-2 antibodies had a comparable rate of fever/chills (67%) and upper respiratory symptoms (56%). Additionally, the most common symptom experienced in our study was the loss of smell and taste (70%).

Alasia et al. found that advanced age and presence of fever, dry cough, dyspnea, fatigue, productive cough, diarrhea, and vomiting were more associated with severe COVID-19 disease among Nigerians in Rivers State [15]. Our cohort did not have any cases of severe COVID-19 illness requiring hospitalization during the study period, and this may be because our cohort is composed of

individuals ages 40 and under.

Our study was not powered to detect a relationship between the number of patients seen and/or intubated and antibody status. A larger study is needed to evaluate further. Another component that could be included in a further study is controlling for outside sick contacts, ensuring that the risk assessed for infection was work-related. Identification of the exposure can be difficult, especially if using the antibody test as a proxy for infection due to the longer time frame for positivity. Additionally, future studies should include vaccination status as a confounding variable for infection.

Lack of PPE at the onset of the pandemic was an issue nationally. More than half of our housestaff polled who developed SARS-CoV-2 antibodies stated they felt the PPE provided to them may have been inadequate.

Only 18 of 64 (28%) housestaff had taken a SARS-CoV-2 PCR test when they answered the survey, despite most reporting symptoms. This is in comparison to 62 of 64 (97%) respondents reporting having an antibody test within the same time frame. PCR testing identifies individuals with acute infection and active viral shedding and is also used to determine isolation needs. Our low reported PCR-testing rate is likely due to the poor availability of PCR testing at the onset of the pandemic and could have contributed to asymptomatic spread of infection. PCR testing was limited to the critically ill and hospitalized despite the presence of COVID-19-like symptoms.

The majority of housestaff, both those with and without antibodies, had symptoms that could be consistent with COVID-19 during the study period. Fever/chills could be considered a good symptom for use in screening, but interestingly, only 66% of those who developed antibodies experienced fevers or chills. Therefore, symptoms alone are not good enough as a screening test. Loss of smell and taste was very specific in identifying individuals with SARS-CoV-2 antibodies. More data is needed to determine if other symptoms are sensitive and specific to identify COVID-19 illness in housestaff. This data is in line with multiple studies showing high false negative rates of SARS-CoV-2 PCR testing and stressing the use of a clinical-based COVID-19 diagnosis [16-18].

The results of this study reinforce the accuracy of symptom-based diagnosis. Asymptomatic pooled PCR testing is another adjunct that can be used to identify individuals shedding viruses.

Our study is hypothesis-generating, and we would like to expand the survey across other emergency departments to gather more data. Since our study demonstrated a much larger percentage of residents experiencing COVID-19 illness compared to prior studies, we believe a larger study across multiple institutions and cities would be the next step in documenting housestaff illness and identifying causative factors, some of which may be possible to address during future waves of COVID-19 or other diseases with a similar spread.

Our study allows for both selection bias and recall bias. The 62% of housestaff who responded to the survey voluntarily may have been more skewed towards individuals who underwent antibody testing and had a particular result. Additionally, the survey retrospectively asked about the adequacy of PPE, and residents who tested positive for antibodies may have felt that due to their illness, they lacked PPE compared to their counterparts. Similarly, when asked retrospectively about symptoms of disease, our housestaff may have over or underreported their symptoms.

Another limitation of our study was the relatively small sample size. Our study only included residents and fellows in two emergency departments in Brooklyn and therefore was underpowered to identify a significant trend in comparing patient encounters and intubations with COVID-19 illness in housestaff.

CONCLUSION

The rate of COVID-19 infection in emergency medicine residents and fellows during the first few months of the 2020 pandemic was 42%, much higher than previously reported. Other significant results include the association of fever and chills and loss of smell and taste with COVID-19 infection and the association of absence of any symptoms with SARS-CoV-2 antibody negativity in housestaff. This calls for continued advocacy for sufficient PPE and more routine PCR testing of

asymptomatic carriers to identify those who are acutely ill shedding.

The authors have no acknowledgments.

The authors received no funding or grants for this study.

The authors have no conflicts of interest to disclose.

The survey and investigation received IRB exemption status from the SUNY Downstate IRB with participant consent waived. No personal information was stored.

This material has not been previously presented.

REFERENCES

1. *World Health Organization. C*oronavirus Disease (COVID-19) - Events as They Happen. Available at: www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen Accessed November 18, 2020.
2. Johns Hopkins University & Medicine. COVID-19 Dashboard by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU). Available at: www.coronavirus.jhu.edu/map.html Accessed November 18, 2020.
3. Centers for Disease Control and Prevention. CDC COVID Data Tracker. Available at: www.cdc.gov/coronavirus/2019-ncov/cases-updates/cases-in-us.html Accessed December 3, 2020.
4. Office of Communications & Marketing, SUNY Downstate Health Sciences University.

STATEMENT ON UNIVERSITY HOSPITAL OF BROOKLYN DESIGNATED BY GOVERNOR CUOMO AS A COVID-19 ONLY FACILITY. Available at: https://www.downstate.edu/news_releases/2020/03-28-2020.html Accessed on December 11, 2020.

5. New York State Department of Health. The NYSDOH Wadsworth Center's Assay for SARS-CoV-2 IgG. Available at: www.coronavirus.health.ny.gov/system/files/documents/2020/04/updated-13102-nysdoh-wadsworth-centers-assay-for-sars-cov-2-igg_1.pdf Accessed December 3, 2020.
6. U.S. Food and Drug Administration. Fact sheet for healthcare providers: SARS-CoV-2 IgG assay - Abbott Laboratories Inc. Available at: www.fda.gov/media/137381/download Accessed December 3, 2020.
7. Hologic. SARS-CoV-2 Assay (Panther Fusion® System). Available at: https://www.hologic.com/sites/default/files/2020-03/AW-21159-001_002_01.pdf Accessed December 11, 2020.
8. Cepheid. GeneXpert® Systems. Available at: https://www.cepheid.com/en_US/systems/GeneXpert-Family-of-Systems/GeneXpert-System Accessed December 6, 2020.
9. Biofire. BioFire's Respiratory Solutions with SARS-CoV-2. Available at: https://www.biofiredx.com/covid-19/ Accessed December 6, 2020.
10. Sabetian G, Moghadami M, Hashemizadeh Fard Haghighi L, et al. COVID-19 infection Among healthcare workers: A cross-sectional study in southwest Iran. *Virology Journal*. 2021;18(1). doi:10.1186/s12985-021-01532-0
11. Breazzano MP, Shen J, Abdelhakim AH, et al. New York City Covid-19 resident physician exposure During exponential phase of pandemic. *Journal of Clinical Investigation*.

2020;130(9):4726-4733. doi:10.1172/jci139587

12. Wang RC, Murphy CE, Kornblith AE, Kurtz T, Kohn MA. Prevalence of SARS-CoV-2 antibodies in emergency Medicine healthcare workers. *Annals of Emergency Medicine*. 2021;77(5):556-557. doi:10.1016/j.annemergmed.2021.01.010
13. Lumley SF, O'Donnell D, Stoesser NE, et al. Antibody status and incidence of SARS-CoV-2 infection in health care workers. *New England Journal of Medicine*. 2021;384(6):533-540. doi:10.1056/nejmoa2034545
14. Shahriarirad R, Khodamoradi Z, Erfani A, et al. Epidemiological and clinical features of 2019 novel coronavirus diseases (COVID-19) in the south of Iran. *BMC Infectious Diseases*. 2020;20(1). doi:10.1186/s12879-020-05128-x
15. Alasia D, Owhonda G, Maduka O, et al. Clinical and Epidemiological characteristics of 646 hospitalised SARS-COV-2 POSITIVE patients in Rivers STATE nigeria: A prospective observational study. *Pan African Medical Journal*. 2021;38. doi:10.11604/pamj.2021.38.25.26755
16. Shahriarirad R, Sarkari B. COVID-19: clinical or laboratory diagnosis? A matter of debate. *Trop Doct.* 2021 Jan;51(1):131-132. doi: 10.1177/0049475520945446. Epub 2020 Aug 6. PMID: 32762302.
17. Kucirka, LM etal. "Variation in False-Negative Rate of Reverse Transcriptase Polymerase Chain Reaction-Based SARS-Cov-2 Tests by Time Since Exposure. *Annals of Internal Medicine*. Aug 18, 2020. https://doi.org/10.7326/M20-1495
18. Michael J. Loeffelholz & Yi-Wei Tang (2020) Laboratory diagnosis of emerging human coronavirus infections – the state of the art, *Emerging Microbes & Infections*, 9:1, 747-756, DOI: 10.1080/22221751.2020.1745095

Supplementary Files

Multimedia Appendixes

This is a letter from the SUNY Downstate IRB confirming this was treated as a service evaluation and thus did not require ethical approval.
URL: http://asset.jmir.pub/assets/9ab8784f9c82add948a3ab55d4af09cf.pdf

CONSORT (or other) checklists

Untitled.
URL: http://asset.jmir.pub/assets/93674f3449f5fc36889bce20b879e540.pdf

CHERRIES Checklist.
URL: http://asset.jmir.pub/assets/70b40bf00a9e326e44c561aabff95a5c.pdf